Chapter 3.5 CHESAPEAKE BAY ASSESSMENT AND PROGRAM INITIATIVES

The Commonwealth of Virginia has 120 miles of Atlantic Ocean coastline and almost 2,500 square miles of estuary. This resource has a prominent place in both Virginia's history and culture. It is valued for its commercial fishing, wildlife, sporting, and recreational opportunities, as well as its commercial values in shipping and industry. In the late 1970's, adverse trends in water quality and living resources were noted and prompted creation of the Federal-Interstate Chesapeake Bay Program (CBP).

Through participation in the CBP and implementation of special state initiatives, Virginia maintains a firm commitment to rehabilitate and wisely manage its estuarine resources. Because nearly all of Virginia's estuarine waters flow into the Chesapeake Bay, the activities of the CBP apply to Virginia's estuaries in general. This chapter provides an overview of the state=s strategies and activities intended to cleanse and preserve the Chesapeake Bay and its tidal tributaries.

Chesapeake Bay Program

In 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the Environmental Protection Agency, and the Chesapeake Bay Commission formally agreed, by signing a Chesapeake Bay Agreement, to undertake the restoration and protection of the Bay using a cooperative Chesapeake Bay Program approach. This approach established specific mechanisms for its coordination among the Program participants. Recognizing the need for an expanded and refined commitment to the Bay=s restoration, a new Bay Agreement was signed in 1987. The new agreement contained goals and priority commitments in six areas: Living Resources; Water Quality; Population Growth and Development; Public Information, Education, and Participation; Public Access; and Governance.

A key Water Quality goal established by the 1987 Agreement was to reduce, by the year 2000, the annual nutrient load of nitrogen and phosphorus entering the Bay from controllable sources by 40%. The starting point, or "baseline", for this reduction effort was the sum total of 1985 point source loads (discharges from municipal and industrial treatment plants) and non-point source loads (runoff from agricultural, forested and urban areas) in an average rainfall year. Achieving this 40% reduction was expected to improve dissolved oxygen levels and water clarity conditions in the Bay, which in turn would help improve the habitats and health of living resources.

In 1992, the nutrient reduction goal was reevaluated using information from a variety of sources, most notably water quality monitoring and modeling programs. As a result, the Bay Program reaffirmed its commitment to the 40% goal in a set of 1992 Amendments to the Bay Agreement. The Amendments also directed that tributary-specific nutrient reduction strategies be developed to achieve and maintain the goal, as well as to protect and improve aquatic habitats within those rivers.

On June 28, 2000, the Chesapeake Executive Council signed *Chesapeake 2000* – a new and far-reaching agreement that will guide Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency (EPA) in their combined efforts to restore and protect the Chesapeake Bay.

Chesapeake 2000 outlines 93 commitments detailing protection and restoration goals critical to the health of the Bay watershed. With pledges to increase riparian forest buffers, preserve additional tracts of land, prevent urban sprawl, restore oyster populations, and protect wetlands, *Chesapeake 2000* strives toward improving water quality as it is the most critical element in the overall protection and restoration of the Bay and its tributaries. At the same time Bay Program partners were developing the new Bay Agreement, the Chesapeake Bay and many of its tidal tributaries were placed on the “impaired waters” list. This action is normally followed by the development of a “total daily maximum load” (TMDL) through a regulatory process.

Chesapeake 2000 seeks to avoid regulatory approaches by achieving water quality improvements prior to the timeframe when a Baywide TMDL would need to be established. To accomplish this goal, Chesapeake Bay Program partners are developing a new process for setting and achieving nutrients and sediment load reductions necessary to restore Bay water quality. This process requires Bay Program partners to continue to build on previous nitrogen and phosphorus reduction goals, but instead of measuring improvement against broad percentage reduction goals, they must now establish and meet specific water quality standards. This new process will also incorporate elements traditionally found in the regulatory TMDL process, such as criteria, standards and load allocations, but also would be developed and applied through a cooperative process involving six states, the District of Columbia, local governments and involved citizens. For the first time, Delaware, New York and West Virginia are formally partnering with EPA, the Bay states and the District to improve water quality watershedwide.

In Virginia, the Department of Environmental Quality (DEQ) has primary responsibility for point source discharge issues, bringing together programs in the areas of surface and groundwater protection, waste management, and air pollution control. The Department of Conservation and Recreation (DCR) has the lead for nonpoint source control programs. Other state agencies that provide vital support include: Game and Inland Fisheries, Forestry, Health, Chesapeake Bay Local Assistance, Marine Resources Commission, Agriculture and Consumer Services, along with higher education units Virginia Institute of Marine Science and Old Dominion University.

Virginia's Tributary Strategy Program

Implementing tributary strategies and reducing nutrient and sediment loads to receiving waters are high-priorities for Virginia. Through the tributary strategy program, substantial resources have been dedicated to this effort and significant progress already has been achieved toward the 40% nutrient reduction goal in the Shenandoah and Potomac River basins. Tributary strategies are currently being implemented for Virginia=s Eastern Shore and the James, Rappahannock and York river basins; and similar reductions and water quality benefits are expected in those basins as well.

Tributary strategies are water quality plans that are cooperatively developed with stakeholders in each river basin. Agencies under the Secretary of Natural Resources work closely with local governments, Planning District Commissions, Soil and Water Conservation Districts, sanitation and wastewater authorities, conservation and river-user groups, and others to develop strategies that are practical, equitable, and cost-effective. Reduction goals are established based on the best available scientific information and water quality model results; and management practices are identified which will help achieve those goals. These point source and nonpoint source practices are then eligible for cost-share funding through Virginia=s Water Quality Improvement Fund (WQIF).

Briefly stated, the current strategy goals for Virginia's lower Bay tributaries are:

<u>Rappahannock</u>: reduce volume of anoxic water (D.O. < 1 mg/l) by 50%; increase the density of underwater grasses by 50%; reduce nitrogen load by 33%, phosphorus load by 29%, and sediment load by 20%.

<u>York</u>: reduce volume of anoxic water by 47%; increase density of underwater grasses by 39%; reduce nitrogen load by 30%, phosphorus load by 44%, and sediment load by 18%.

<u>James</u>: focusing on the tidal fresh region below Richmond - increase density and acreage of underwater grasses; reduce algae levels by about 50%; reduce nitrogen load by 32%; phosphorus load by 39%; sediment load by 9%; improve river bottom habitat in non-tidal region through reduced sediment loads.

<u>Eastern Shore</u>: increase the areas and density of underwater grass in tidal creeks and embayments to historic levels; enable the return of abundant and diverse fish and shellfish; targeted actions reduce nitrogen load by 33%, phosphorus load by 43%; sediment load by 30%.

Details on the tributary strategy program can be found in the Secretary of Natural Resources report: “2001 Annual Report on Implementation of the Chesapeake Bay Agreement, Status of the Tributary Strategies, and Status of Water Quality for Virginia's Chesapeake Bay and Tributaries”. A brief overview is provided in the following sections of this report.

Shenandoah-Potomac Tributary Nutrient Reduction Strategy

In December of 1996, Virginia completed the Shenandoah and Potomac River Basin Tributary Nutrient Reduction Strategy (Strategy). The Strategy was the culmination of three years of cooperative work among several of Virginia=s Natural Resources agencies, local government officials and other interested citizens and stakeholders. The Strategy outlines point and nonpoint source management actions that were needed to achieve the 40% nutrient reduction goal for this river basin by the deadline of December 31, 2000. Implementation rates for these practices have been very high in response to the cost-share program that was established under the Water Quality Improvement Act. As a result, implementation of point source and nonpoint source management practices has taken us a major step closer to meeting the challenging 40% nutrient reduction goal.

Point Source Nutrient Reduction Actions in the Shenandoah/Potomac Basin

Progress continues to be made on point source nutrient reduction projects under the provisions of seventeen signed WQIF grant agreements in the Shenandoah and Potomac River basins. These projects account for approximately $75.54 million in cost-share (50%) for the design and installation of nutrient reduction systems. To date, over $57 million has been reimbursed to these grantees for work accomplished. Once operational, these systems will remove an estimated 7,407,000 pounds of nitrogen and 241,300 pounds of phosphorus per year.

Nonpoint Source Nutrient Reduction Actions in the Shenandoah/Potomac Basin

Non-point implementation activities identified in the Shenandoah-Potomac tributary strategy were completed in December of 2000. Based on the sign-up through December 2000 for cost-share to install nonpoint source Best Management Practices (BMP's), a 40.9% reduction in annual controllable nitrogen loads and a 40.7% reduction of the controllable phosphorus load were achieved.

The principal nonpoint source components of the strategy included agricultural BMP's and agricultural nutrient management planning. The agricultural BMP's were implemented through Virginia's Cost-Share Program, which is administered locally by the Soil and Water Conservation Districts. Nutrient management planning was accomplished through a combined effort of Department of Conservation and Recreation nutrient management staff, local soil and water conservation district staff and private certified nutrient management planners.

Nutrient and Sediment Reduction Strategies for Virginia=s Lower Chesapeake Bay Tributaries

The reevaluation of the Bay wide nutrient reduction goal, conducted in 1991-92, which lead to the adoption of the 1992 Amendments, yielded an important finding about Virginia's lower Bay tributaries and their impact on the Bay's water quality. It was determined that the nutrient loads from the Potomac River basin and basins to the north have the greatest influence on conditions in the mainstem Bay, whereas the southern tributaries -- the Rappahannock, York, James and small coastal basins -- contribute little, if any, to the mainstem Bay's water quality problems in terms of excess nutrient impacts.

These southern Bay tributaries however have water quality problems within them which need to be addressed. Thus the goal setting process and the final reduction goals for each of the lower tributaries reflect both the unique water quality and habitat conditions of each tributary, as well as the characteristics of each tributary basin.

Implementation of Virginia=s lower Bay tributary strategies has begun. Point source nutrient reduction projects are proceeding under 8 signed WQIF agreements awarding $23.5 million in cost-share. Once on-line, these systems will remove about 6.29 million pounds of nitrogen and 1,400 pounds of phosphorus annually. It is anticipated that this implementation phase will lead to specific improvements in the water quality problems that have been identified in each tributary.

Mid Atlantic Integrated Assessment (MAIA)

In 1997 and 1998, the U.S. Environmental Protection Agency in partnership with other Federal and state programs conducted research on an integrated monitoring approach for Mid-Atlantic estuaries (http://www.epa.gov/emap/maia/). The geographic area covered included the watersheds of the Delaware Estuary, Chesapeake Bay, Delmarva coastal bays, and Albermarle-Pamlico System. The objectives of this research program were to: (1) characterize the ecological condition of the Mid-Atlantic estuaries using a common set of measurements applied over the entire area, (2) focus research on small estuarine systems to determine better monitoring approaches for these critical systems, and (3) to demonstrate that effective partnerships can be established among Federal and state agencies with estuarine responsibilities in the pursuit of scientific data for resource management purposes. Data from this sampling program were used in this 305b report.

Over 700 sampling sites were visited during the summer of 1997, with the emphasis at the majority of the sites on water and sediment quality. These included sites selected using statistical survey designs (random selection) and fixed station survey designs (targeted selection). Since one of the objectives of the research program was to further investigate small estuarine systems, more emphasis was placed on these systems by spatial intensification of sampling in selected areas. Over 500 sampling sites were selected for monitoring during the summer of 1998, with fish trawling conducted at over 120 sites. These also include sites selected using statistical survey designs (random selection) and fixed station survey designs (targeted selection).

A unique aspect of this collaborative research program was the sampling for a set of consistent measurements across the Mid-Atlantic estuaries. The list of the parameters collected was developed in conjunction with Federal, state, and county authorities to address critical scientific issues affecting these estuaries. These parameters focus on many aspects of the estuarine biotic community, both plants and animals, as well as provide important information about the exposure to stresses in the estuarine environment. In general, the measurements include data on fish and shellfish, benthic (bottom-dwelling) community structure, water quality, toxic contaminants in bottom sediment, and sediment toxicity.

Toxics, Pollution Prevention, and Businesses for the Bay

The “Toxics 2000 Strategy” of the Chesapeake 2000 Agreement recommits to the 1994 Toxics Strategy goal of a “Chesapeake Bay free of toxics by reducing or eliminating the input of chemical contaminants….” The strategy embraces the concepts of voluntary “pollution prevention”, “reduction”, and “elimination” as the means to reaching this goal. Furthermore, the strategy relies heavily upon the expected achievements of participants in the voluntary pollution prevention program Businesses for the Bay.

Pollution prevention (or P2) includes a hierarchy of activities and techniques to reduce or eliminate wastes and/or reduce the toxicity of chemicals used at the source of production. P2 was embraced by the Chesapeake Bay’s Executive Council because many P2 techniques not only decrease chemical discharges and waste generation, but also result in increased production efficiency and reduced waste disposal costs for businesses. For this reason, business and industry have been the leaders in developing many P2 techniques and are proponents of this voluntary approach to eliminating or reducing the generation of wastes.

Working closely with representatives from business and industry, the EPA’s Chesapeake Bay Program and the Pollution Prevention programs of the Bay states helped craft Businesses for the Bay, a voluntary pollution prevention program designed to encourage industry to adopt pollution prevention principles. The Executive Council approved the program in October 1996 and Virginia kicked off its program in January 1997.

Membership in Businesses for the Bay is open to all businesses and other facilities in the Bay watershed, including federal, state, and local government facilities. Each participating facility annually develops its own P2 goals and reports back on its progress of the previous year's efforts. The program also supports a business-to-business mentoring program, and individual “experts” from member facilities have volunteered to provide assistance to others. Members not only benefit from cost savings and increased efficiencies, but also from positive publicity, increased patronage, access to mentoring services, and eligibility for annual awards from the Executive Council.

In 2001, the Executive Council recognized 14 Businesses for the Bay participants for their outstanding achievements; and 7 of them were from Virginia:

- Outstanding Achievement Large Business: Siemens Automotive Corp., Newport News
- Honorable Mention Large Business: Lee’s Carpet, Glasgow
- Outstanding Achievement Retail Business: Target Corporation
- Outstanding Achievement Nutrient Reduction: Merck & Company, Inc., Elkton
- Outstanding Achievement Medium Business: Beers/Heyward & Lee Construction Company, Richmond
- Significant Achievement Small Business: Southern States Cooperative, Inc., Chesapeake
- Outstanding Achievement Government Facility: Marine Corps Base Quantico

To date, there are more than 450 participants and 90 mentors in Businesses for the Bay. In 2000, participants reported approximately 23 million pounds of waste reductions, 1.2 billion pounds of recycling, and nearly $15 million in cost savings due to pollution prevention efforts. Virginia accounts for 230 Businesses for the Bay members and 60 of its mentors. In 2000, Virginia members achieved reductions of 10 million pounds, 114 million pounds of recycled material, 2.1 billion gallons of water use reduction, and more than $2.1 million in cost savings.

As mentioned, the new Toxics 2000 Strategy includes challenging numeric goals for Businesses for the Bay:

- Businesses for the Bay participants will prevent or recycle a total of one billion pounds of hazardous substances between 1999 and 2005.
- By 2005, Businesses for the Bay will have 1,000 participants throughout the watershed; and 50% will be small businesses with fewer than 100 employees.
- By 2005, Businesses for the Bay will have a total of 300 individuals volunteer as mentors to provide P2 assistance; and these mentors will annually conduct 500 interactions with those in need.

The Virginia DEQ’s Office of Pollution Prevention actively promotes Businesses for the Bay through a variety of approaches, including newsletter and newspaper features, numerous presentations, directed mailings, and site visits to its member facilities. In support of the efforts of Businesses for the Bay, Virginia has pursued partnerships and reciprocal agreements with other P2 initiatives, such as the Virginia Environmental Excellence Program, the Elizabeth River Project, the Virginia Clean Marinas Program, and the DEQ/Department of Defense P2 Partnership. Virginia DEQ also coordinates Businesses for the Bay mentoring activities through the Virginia Mentoring Network on-line database at www.deq.state.va.us/vmn/vmnindex.htm.

For more information, please access the Businesses for the Bay website at www.chesapeakebay.net/b4bay.htm. You may also contact VA DEQ’s Benji Brackman at 804-698-4549 or enbrackman@deq.state.va.us or the Businesses for the Bay Coordinator Marylynn Wilhere at 1-800-YOURBAY or wilhere.marylynn@epa.gov.

Chesapeake Bay Water Quality and Habitat Monitoring Program

Monitoring is vital to understanding environmental problems, developing strategies for managing the Bay's resources, and assessing progress of management practices. The purpose of the Chesapeake Bay Program (CBP) Water Quality and Habitat Monitoring Program is to assess trends in water quality and living resources throughout the Virginia portion of the Bay. The productivity, diversity, and abundance of living resources are the ultimate measures of the Chesapeake Bay's condition. Monitoring these organisms along with standard chemical (e.g. nutrients) and physical indicators of water quality can help determine the conditions that must be established and maintained to ensure the well being of the Bay's resources.

A general description of the monitoring program is:

- X Water quality monitoring at 38 stations on the Rappahannock, York and James Rivers;
- X Water quality monitoring at 27 stations in the Chesapeake Bay mainstem;
- X Water quality monitoring and estimates of nutrient loading at "River input" stations on the James, Appomattox, Mattaponi, Pamunkey, and Rappahannock Rivers;
- X Monitoring of phytoplankton and zooplankton communities in the mainstem of the Chesapeake Bay at 7 stations and in the tributaries at 6 stations;
- X Monitoring of benthos communities in the Bay and its tributaries at 19 fixed stations and 100 random stations per year.

Chesapeake Bay Environmental Status and Trends Information

This section presents information about key ecological conditions and trends in the tidal portions of the Virginia Chesapeake Bay, and its major tributaries (i.e., Potomac, Rappahannock, James, and York Rivers). The water quality conditions discussed are directly affected by nutrient loading changes and in turn directly affect living resources of the Bay. These water quality conditions are: nutrient (nitrogen and phosphorus) loads, nutrient concentrations, chlorophyll, water clarity, suspended solids, and dissolved oxygen. Environmental information regarding other important conditions in Chesapeake Bay (e.g., submerged aquatic vegetation, plankton communities, benthos communities, fisheries, toxicants) are not presented here but are available from the Department of Environmental Quality in "Chesapeake Bay and its Tributaries: Results of Monitoring Programs And Status of Resources; 2002 Biennial Report of the Secretary of Natural Resources to The Virginia General Assembly, January 2002".

Table 3.5-1 presents the annual nitrogen and phosphorus loads discharged from point sources within each of Virginia's tributary basins. The table also shows the percent change in loads when compared to the 1985 baseline. Overall, in Virginia's Bay watershed the percent reduction for the annual point source phosphorus load between 1985 and 2000 is 56%, and for nitrogen it is 23%. In comparison to the 1999 loadings, the phosphorus load was slightly higher (182,600 lbs/yr more; only a 3% change), and the nitrogen load was also somewhat higher (288,840 lbs/yr more; just a 1% change). These modest changes are attributable to an increase of about 13.7 million gallons per day of treated discharge from the facilities tracked, as well as the addition of five municipal plants and one industrial discharge to the loading estimate.

Steady progress has been maintained in reducing point source phosphorus loads due to the phosphate detergent ban (1988) and installation of phosphorus control systems at all the major plants discharging to the tidal portions of the Bay tributaries. The nitrogen reduction effort was aided in 2000 with the start-up of biological nutrient removal (BNR) systems at several plants. Using cost-share grants from the Water Quality Improvement Fund (WQIF), the projects that came on-line included the FWSA-Opequon STP, HRRSA-North River STP, and SIL Clean Water MRRS, all in the Potomac basin. Significant additional reductions will occur as the remainder of WQIF projects are completed over this year and into 2002. Future point source reductions in the lower Bay tributaries will result from the addition of nine facilities in the WQIF cost-share program.

Table 3.5 - 1 2000 Virginia Point Source Nutrient Loads, with percent changes from 1985 baseline.

River Basin	Number Of Plants	2000 Phosphorus Load (lbs/yr)	Phosphorus % Change from 1985	2000 Nitrogen Load (lbs/yr)	Nitrogen % Change from 1985
Shen/Potomac	38	521,350	-32%	12,008,360	+11%
Rappahannock	13	53,660	-71%	588,070	+20%
York	8	184,220	-59%	1,220,360	-12%
James	32	1,421,040	-61%	13,614,180	-43%

Coastal	8	143,200	-57%	1,701,260	+31%
Totals	**99**	**2,323,470**	**-56%**	**29,132,230**	**-23%**

Table 3.5-2 presents the total annual phosphorus, nitrogen and sediment load from nonpoint sources in each of Virginia's Bay tributary basins. The table also shows the percent change in loads when compared to the 1985 baseline. The loading estimates are results based on the Year 2000 Progress Run of Phase 4.3 of the Chesapeake Bay Watershed Model. This Progress Run accounts for implementation of all the Best Management Practices (BMPs) that are tracked through the Agricultural BMP Cost-Share Program, known urban stormwater control activities, and estimates of other voluntary, non-cost shared BMPs.

Table 3.5-2 Virginia Nonpoint Source Nutrient Loads – 2000

River Basin	2000 Phosphorus Load (lbs/yr)	Phosphorus % Reduction from 1985	2000 Nitrogen Load (lbs/yr)	Nitrogen % Reduction from 1985	2000 Sediment Load (lbs/yr)	Sediment % Reduction from 1985
Shen/Potomac	1,660,000	10.1%	13,970,000	9.5%	720,000	14.8%
Rappahannock	880,000	18.6%	7,520,000	18.8%	330,000	21.2%
York	660,000	12.5%	6,890,000	12.1%	140,000	12.5%
James	4,500,000	1.1%	22,810,000	2.3%	1,200,000	7.5%
Coastal	200,000	9.7%	2,120,000	2.4%	20,000	0%
Totals	**7,900,000**	**5.8%**	**53,310,000**	**7.2%**	**2,410,000**	**10.5%**

The Chesapeake Bay and its tidal tributaries show many improving environmental trends indicating progress toward restoration to a more balanced and healthy ecosystem as a result of reducing these nutrient loads. However, the Bay system remains degraded and some areas and some indicators show continuing degradation. Findings from the monitoring program are highlighted below and discussed further in the following pages.

- Phosphorus levels in water entering the Bay from the watershed are reflecting both point and nonpoint source nutrient load reductions by showing improving trends in many areas. Within the tidal waters themselves, there are also some improving trends observed and no degrading trends. Unfortunately, several improving trends in the segments of the York and Rappahannock noted in last year's analysis have leveled off such that phosphorus levels are no longer declining in these segments.

- Nitrogen levels are showing very widespread improving trends. Water entering from the watershed has decreasing nitrogen levels in most of the major tributaries. Almost every section of the tidal rivers and the Virginia Chesapeake Bay also show improving conditions.

- Levels of dissolved oxygen are improving in increasingly widespread areas of the tidal rivers. However, conditions for dissolved oxygen still remain only fair in much of the Virginia Chesapeake Bay and a few of the river segments near the Bay. The Corrotoman River is the only area indicating degrading conditions for dissolved oxygen levels.

- Water clarity, a very important environmental parameter, is generally poor and degrading in many areas near and in the Virginia Chesapeake Bay. This is probably related to high and increasing levels of suspended solids. These degrading conditions in the Virginia Chesapeake Bay may be causing degradation of zooplankton populations and are a major impediment to restoration of submerged aquatic vegetation (SAV).

- Chlorophyll levels are moderately high throughout much of the tidal waters. Several new degrading trends are evident in this reporting period and are indicative that nutrient levels, though generally improving, are still detrimentally high.

Phosphorus: Nutrients such as nitrogen and phosphorus influence the growth of phytoplankton in the water column. Elevated concentrations of these nutrients can result in excessive phytoplankton production (i.e., algal growth rate). Decomposition of the excess resulting organic material during the summer can result in low levels of dissolved oxygen in bottom waters. These low oxygen levels (anoxic or hypoxic events) can cause fish kills and drastic declines in benthic communities which are the food base for many fish populations. Anoxic waters also adversely affect fish and crab population levels by limiting the physical area available for these organisms to live in.

Figure 3.5-1 presents the current status and long term trends (1985-2000) in phosphorus concentrations. Areas of the Elizabeth, lower James, and York have the poorest conditions in relation to the rest of the Chesapeake Bay system. Other segments of rivers are fair but the mainstem Virginia Chesapeake Bay and the upper portions of the tidal rivers have relatively good conditions. The Awatershed input≅ stations shown in figure 1 provide information about the success of nutrients control efforts in the Bays watershed. Results at these watershed input stations are adjusted to remove the effects of riverflow and therefore assess the effect of nutrient management actions such as point source discharge treatment improvements and best management practices to reduce non-point source runoff. The watershed input stations on the largest of VA tributaries (Rappahannock, James) show improving concentration trends (i.e., decreasing concentrations of phosphorus). The James is the only river where actual phosphorus loads (i.e. total pounds of phosphorus entering from the watershed via riverflow) have declined. This is a result of both a declining riverflow volume as well as the declining phosphorus concentration. Riverflow volume has not changed in the other rivers. The improving concentration trends are probably a result of the Phosphate detergent ban as well as best management practices for the control of non-point sediment and nutrient runoff. The watershed input of the Pamunkey indicates a degrading trend; suggesting management efforts to control phosphorus runoff have not been as effective in this basin. The problem is likely a combination of both point and non-point sources because both dissolved orthophosphorus (commonly from point sources) and suspended sediment (commonly from non-point sources) are also degrading at this station.

> The terms good, fair, and poor used in conjunction with nitrogen and phosphorus conditions are statistically determined classifications for comparison among areas of similar salinity within the Chesapeake Bay system. Though useful in comparing current conditions among different areas of the Chesapeake Bay system, it must be remembered that these terms (good, fair, poor) are not absolute evaluations but only evaluations relative to other areas of a generally degraded system. Several major scientific studies have shown that the Chesapeake Bay system is currently nutrient enriched and has excessive and detrimental levels of nutrient and sediment pollution. Given this, it is likely that an absolute evaluation in relation to ideal conditions would indicate that most water quality parameters are currently poor throughout the whole Bay system.
>
> The Monitoring Subcommittee of the Federal-Interstate Chesapeake Bay Program continues to develop additional methodologies for water quality status evaluations which in the future will be used in conjunction with, or possibly in replace of, the current methods.

Decreasing phosphorus concentrations in the riverflow entering from the watershed have had widespread positive impacts on phosphorus concentrations in the tidal waters. Trends prior to 1998 indicated concentrations increasing in many areas but analyses in the last several years have found that these degrading trends were reversed and now there are widespread improving conditions for phosphorus. Of concern in this annual report is the fact that previously improving trends in tidal Mattaponi, Pamunkey, and York segments have now leveled off and are no longer present. This is due to increasing trends in dissolved inorganic form of phosphorus throughout these same segments; trends which fortunately are not present in any of the other tributaries. These increasing inorganic phosphorus trends are of concern because they may be the cause of increasing chlorophyll levels found for the first time this year in the Mattaponi, Pamunkey and downstream York segments (see figure 3).

Nitrogen: Figure 3.5-2 presents the status and long term trends (1985-2000) in nitrogen concentrations. As with phosphorus, management actions to reduce nitrogen have been effective as indicated by improving conditions at nearly every watershed input station. The major exception is the Pamunkey, where anthropogenically influenced concentrations of nitrogen are increasing this reporting period for the first time. Also as with phosphorus, the loading of nitrogen has remained unchanged in all rivers except the James, where it has declined. This is a result of both a declining riverflow volume as well as the declining nitrogen concentration. Riverflow volume has not changed in the other rivers. Management actions also have created very widespread improving trends throughout the tidal waters.

Status in the upper Potomac River and parts of the Elizabeth are worse than those found in the major southerly tributaries (Rappahannock, York, and James) or the Virginia Chesapeake Bay. Much of the Rappahannock, York, and James and Virginia Chesapeake Bay have good status relative to other Bay waters of similar salinity.

Chlorophyll: Chlorophyll *a* is a measure of the level of algal (i.e., phytoplankton) biomass in the water. High chlorophyll *a* or algal levels are an indicator of poor water quality because they can lead to low dissolved oxygen conditions when the planktonic organic material sinks into bottom waters and is decomposed. High algal levels can also be a factor in reduced water clarity and reducing the amount of light that reaches Submerged Aquatic Vegetation (SAV).

Figure 3.5-3 presents the current status and long term trends (1985-2000) in chlorophyll concentrations. Parts of all major tributaries (Potomac, Rappahannock, York, and James) have borderline status in relation to the chlorophyll's contribution to decreased water clarity and its effect on growth of submerged aquatic vegetation. There are widely scattered segments where chlorophyll levels are degrading (i.e. concentrations are increasing) with the only improving trend in the western branch Elizabeth river. The continuing degradation and lack of improving chlorophyll levels despite the many improving nutrient conditions means that nutrient levels are still too high and further reductions will be necessary before chlorophyll levels are improved. Pamunkey, Mattaponi, and York segments have degrading trends for the first time during this annual reporting period. As noted previously, these trends are probably a result of the increasing phosphorus concentrations noted in these same segments.

Dissolved Oxygen: Dissolved oxygen is an important factor affecting the survival, distribution, and productivity of living resources in the aquatic environment. Figure 3.5-4 presents the current status and long term trends (1985-2000) in dissolved oxygen concentrations. Status of each segment is given in relation to dissolved oxygen levels supportive of living resources. About half of the Virginia Chesapeake Bay and smaller portions of the tidal tributaries have only fair status. The lower Potomac, lower Rappahannock, and northernmost Virginia Chesapeake Bay segments are indicated as poor or fair partly because of low dissolved oxygen in the bottom waters of mid-channel trenches. These mid-channel trenches naturally have lower dissolved oxygen levels but the spatial and temporal extent of low levels has been exacerbated by anthropogenic nutrient inputs. It is very encouraging that each of the last several annual reports has found new improving trends. There are now improving conditions in segments of all the major tributaries (Potomac, Rappahannock, James, and Elizabeth). The only degrading trend occurring is in the Corrotoman River.

Figure 3.5-3) Chlorophyll Status and Trends

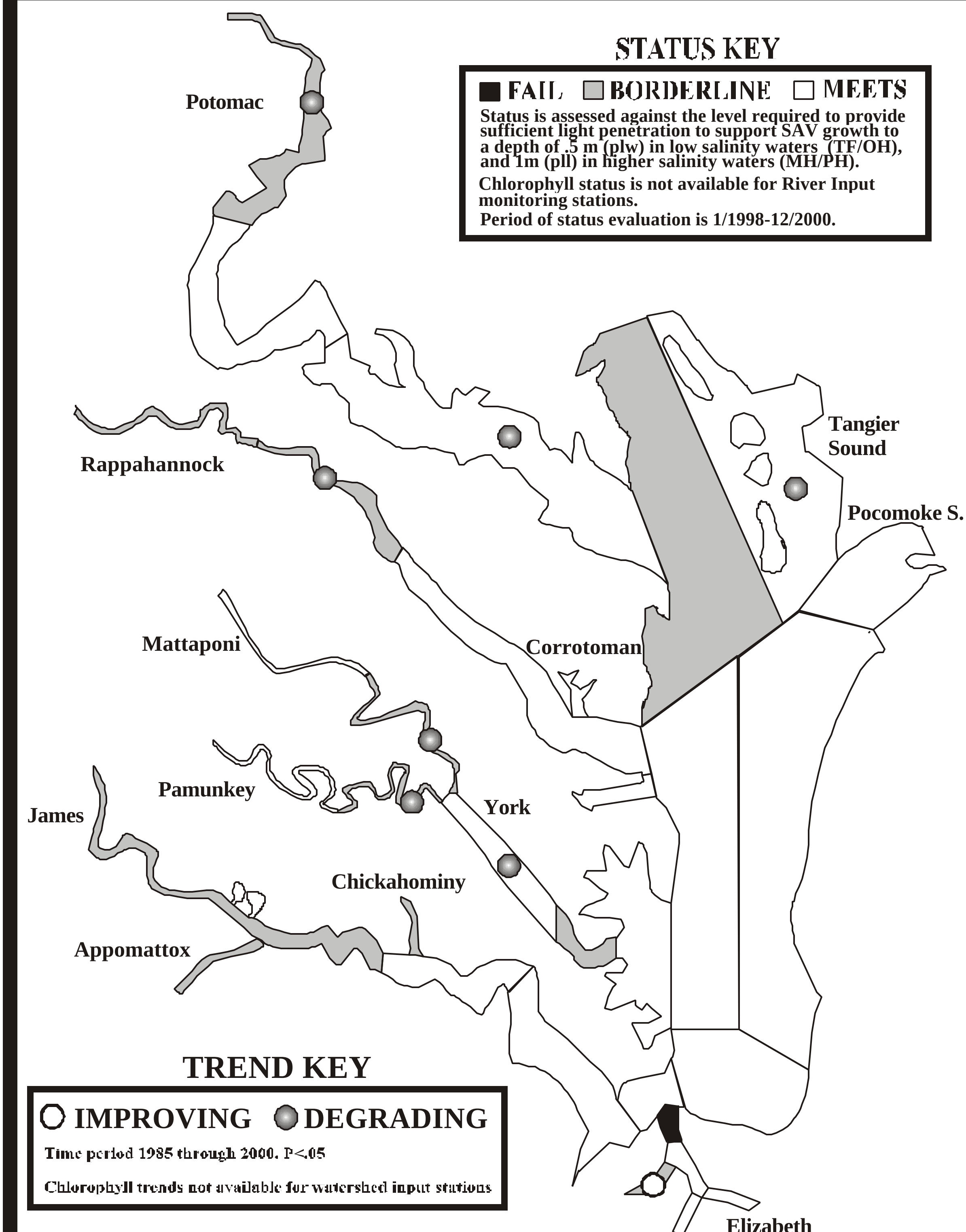
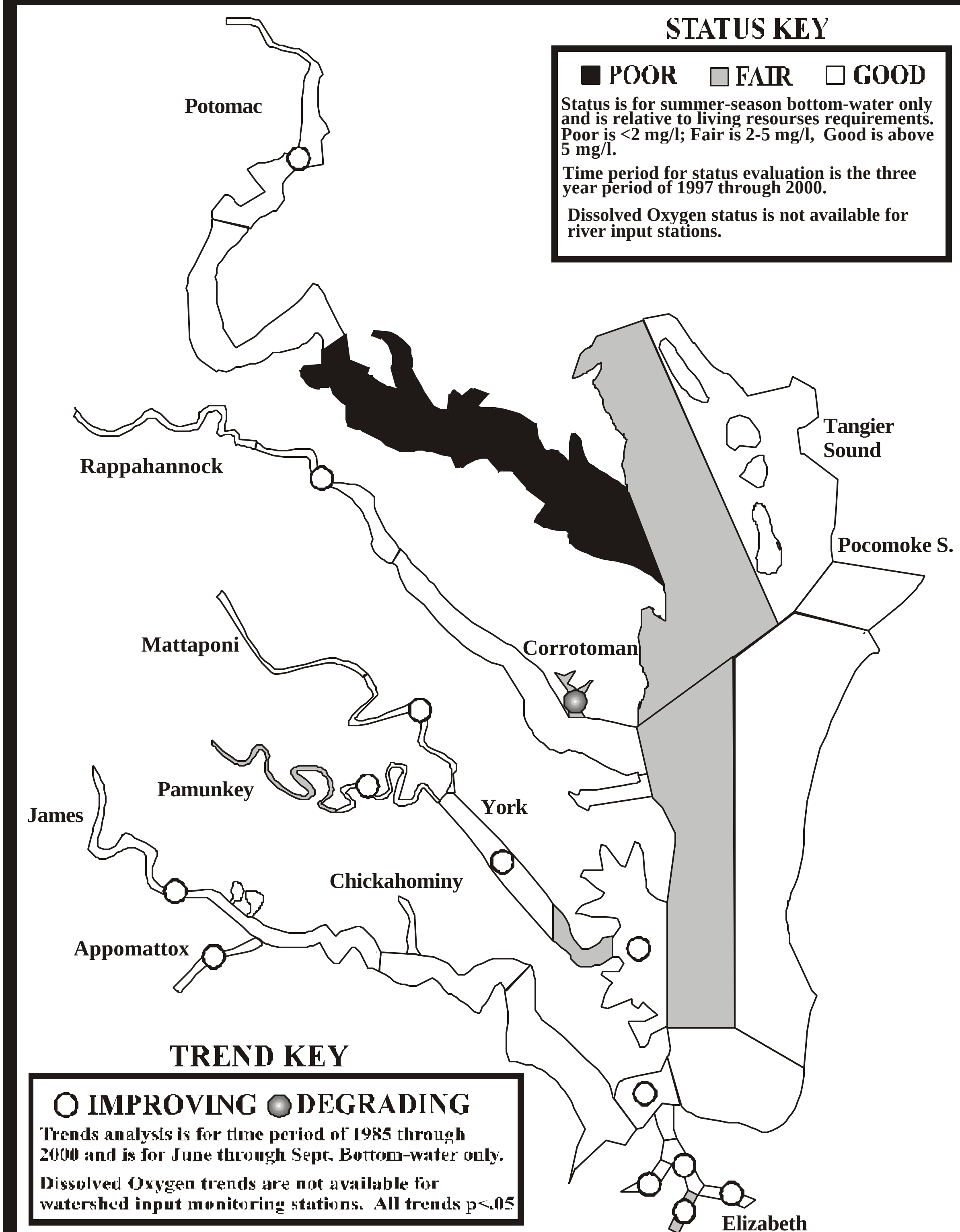


Figure 3.5-4) Dissolved Oxygen Status and Trends



Water Clarity: Water clarity is a measure of the ability of sunlight to penetrate through the water. Poor water clarity is an indication that conditions are inadequate for the growth and maintenance of submerged aquatic vegetation (SAV). Poor water clarity can also affect the health and distributions of fish populations by changing their ability so see prey or avoid predators. The major influences on water clarity are: 1) concentrations of particulate inorganic mineral materials (e.g., sand or clays), 2) concentrations of planktonic algae (i.e., phytoplankton), 3) concentrations of particulate detrital organic material (e.g., very small particles of dead algae or decaying marsh grasses), and 4) dissolved substances which >color= the water (e.g., brown humic acids generated by plant decay). Which of these factors is dominant can vary seasonally and spatially.

Figure 3.5-5 presents the current status and long term trends (1985-2000) in water clarity. Poor water clarity is one of the major environmental indicators of degradation in the Chesapeake Bay system and is a major factor hindering the resurgence of submerged aquatic plant growth because the status is only borderline or failing the target in many segments. There are also widespread areas where further degradation of water clarity is occurring, especially in the lower tributaries and Virginia Chesapeake Bay. One of the reasons for these degrading trends is possibly the high level of riverflow in several recent years. Other possible reasons are increased shoreline erosion as a result of waterside development or even some combination of sea level rise and land subsidence.

Suspended Solids: Suspended solids are a measure of the small particulates in the water, a combination of items 1-3 listed in the above discussion of water clarity. Suspended solids directly affect water clarity for submerged aquatic vegetation and are most often the major controlling factor. Elevated suspended solids can also be detrimental to the survival of oysters and other aquatic animals. Oysters can be smothered by deposition of the material and the feeding of filter feeding fish (e.g., menhaden) can be negatively effected. In addition, since suspended solids can contain organic and mineral components containing nitrogen and phosphorus, increases in suspended solids can result in an increase of nutrients.

Figure 3.5-6 presents the current status and long term trends (1985-2000) in suspended solids concentration. Parts of all major tributaries (Potomac, Rappahannock, York, James, and Elizabeth) have segments that fail or are borderline in relation to targets to support growth of submerged aquatic vegetation. The improving trends in flow-adjusted concentration at the watershed input stations of the Potomac and Rappahannock are encouraging signs that management actions to reduce NPS sediment runoff may be having some success. However, there are several degrading trends in the tributaries and some of the Virginia Chesapeake Bay mainstem. As with water clarity, reason for these degrading trends are possibly high levels of riverflow, or tidal shoreline erosion. A previously degrading trend in Tangier Sound is no longer present in this reporting period. This is very encouraging because this area has major beds of submerged aquatic vegetation that are very important refuge and habitat for many aquatic animals.

Figure 3.5-5) Water Clarity Status and Trends

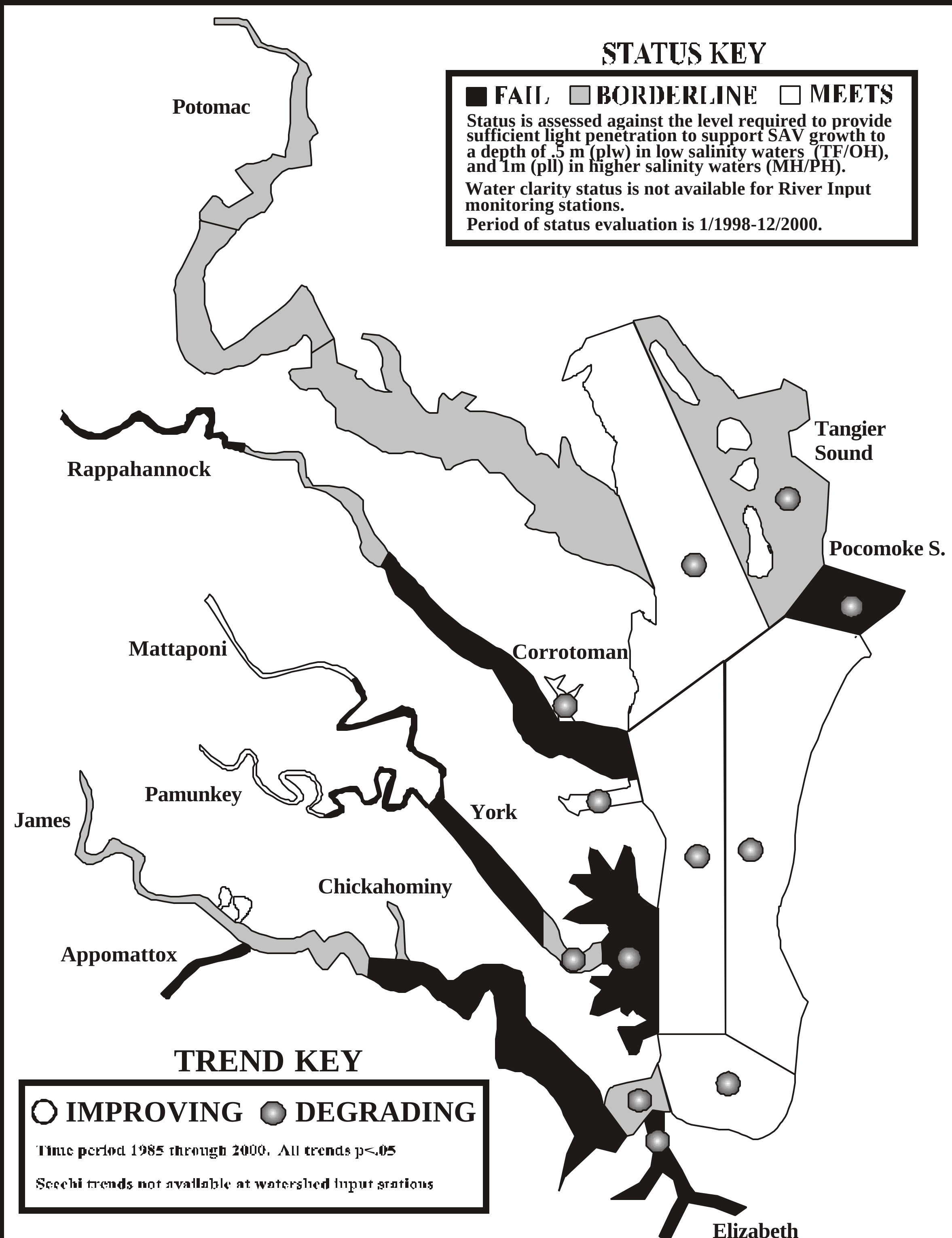
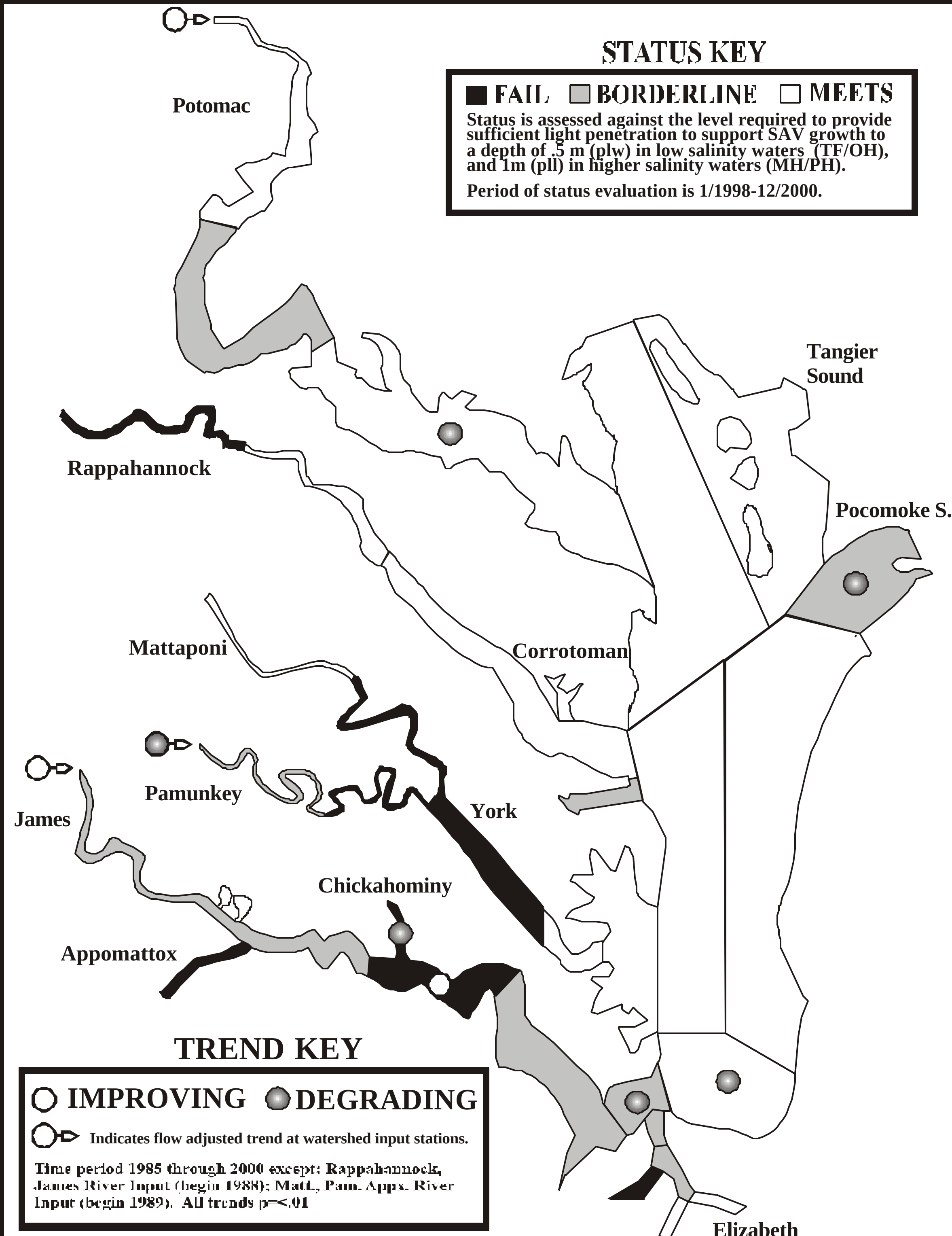


Figure 3.5-6) Suspended Solids Status and Trends



In 1999, the Chesapeake Bay Program's Toxics Subcommittee completed a toxics characterization (see Figure 3.5-7 and Table 3.5-3) of the tidal tributaries of the Chesapeake Bay (*U.S. EPA, 1999. Targeting Toxics: A Characterization Report. A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers. Chesapeake Bay Program, U.S. EPA 903-R-99-010, 1999, 49 pp. and appendices*). The characterization served a dual purpose for the Chesapeake Bay Program and its partners: 1) it was utilized as a guide in the development of the Toxics 2000 Strategy, and 2) it continues to provide the basis to direct management actions, such as toxics monitoring. The characterization process directed the placement of each pre-defined regional area into one of four categories based on chemical contaminant exposure and biological effects. Two contrasting areas include Regions of Concern (e.g., Elizabeth River) which are highly impacted areas and Areas of Low Probability for Adverse Effects which are regional areas that are not impacted by chemical contaminants. Areas of Emphasis have the potential for serious chemical contaminant-related impacts and a fourth category included Areas of Insufficient or Inconclusive Data, where the data were insufficient to place the area into one of the three categories above.

Table 3.5-3) 1999 Chemical Contaminant Characterization Results

VIRGINIA TIDAL TRIBUTARIES	TOXICS CHARACTERIZATION RESULTS
James River	Tidal Upper Segment: Area of Insufficient Data Tidal Middle Segment: Area of Insufficient Data Tidal Lower Segment: Area of Emphasis
York River	Tidal Pamunkey: Area of Insufficient Data Tidal Mattaponi: Area of Insufficient Data Upper Middle York: Area of Insufficient Data Lower Middle York: Area of Low Probability for Adverse Effects Upper Mobjack Bay: Area of Low Probability for Adverse Effects Lower Mobjack Bay: Area of Insufficient Data
Rappahannock River	Tidal Upper: Area of Low Probability for Adverse Effects Tidal Middle: Area of Insufficient Data Tidal Lower: Area of Low Probability for Adverse Effects
Potomac River (western shore)	Tidal Upper: Area of Emphasis Tidal Middle: Area of Emphasis Tidal Lower: of Low Probability for Adverse Effects

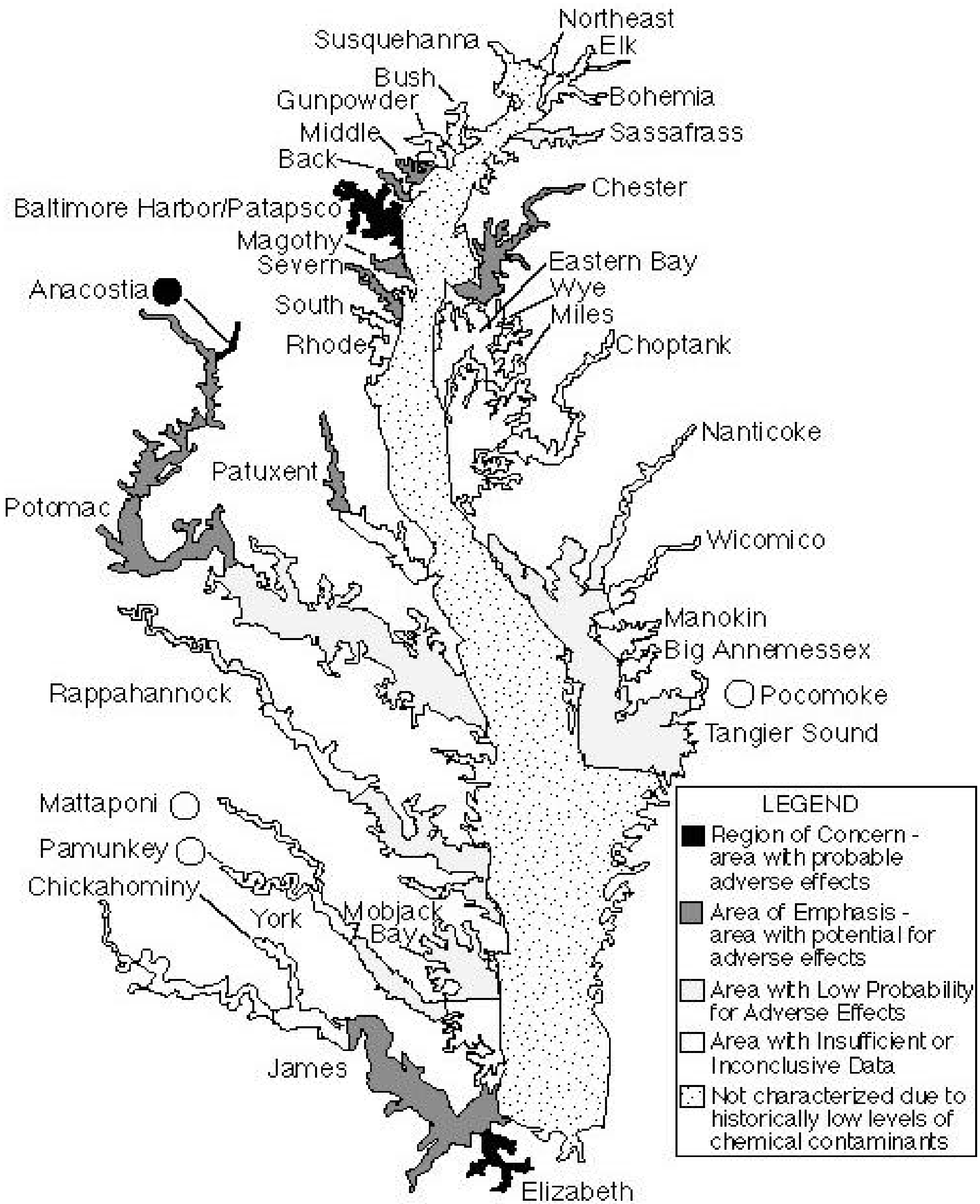
Source: Targeting Toxics: A Characterization Report, A Tool for Directing Management and Monitoring Actions in the Chesapeake Bays Tidal Rivers EPA 903-R-99-010, CBP/TRS 222/106, June 1999

Recent Chemical Contaminant Monitoring in Areas of Insufficient Data not reported in 1999 are:

- <u>Upper and Middle Tidal James River</u> – Even though chemical contaminant data were available for the 1999 toxics characterization, biological "effects" data were lacking which precluded a full characterization. To fill in the data gaps for a definitive characterization, the EPA Chesapeake Bay Program, along with DEQ, funded biological and chemical contaminant monitoring in these James River segments in late summer/early fall of 2000.

  DEQ in a partnership with the Virginia Institute of Marine Science (VIMS) performed full chemical contaminant analyses of the water column and sediment along with ambient toxicity tests, in-situ assays and benthic community assessments. Twenty (20) stations were randomly located in this freshwater tidal area from Jamestown Island to the Benjamin Harrison Bridge near Hopewell. The water column and sediment results suggest there may be low incidence of biological effects from chemical contaminants in this stretch of the James River. The observance of low chemical contaminant levels and the lack of toxicological impacts supported this conclusion. While this study was designed to make statements about the entire segment, conclusions from this study cannot rule out the possibility for locally impacted areas.

Figure 3.5-7) Status of Chemical Contaminant Effects on Living Resources in the Chesapeake Bay's Tidal Rivers



Another Chesapeake Bay Program sponsored study performed a sediment quality triad (chemical, toxicity tests, benthos) survey at five (5) stations in the middle tidal segment of the James River near the confluence of the Chickahominy. The authors suggested this segment could be characterized as an Area of Low Probability for Adverse Effects due to chemical contaminants River (*McGee, B. L., D.J. Fisher, J. Ashley, D. Velinsky. 2001. Using the Sediment Quality Triad to Characterize Toxic Conditions in the Chesapeake Bay (1999): An Assessment of the Tidal River Segments in the Bohemia, Magothy, Patuxent, Potomac, James, and York Rivers. U.S. EPA 903-R-01-008. Chesapeake Bay Program Office, Annapolis, MD, 2001, 35 pp. and appendices*).

In a continuation of the VIMS/DEQ partnership during the fall of 2001, a sediment quality triad study was performed on the James River between Hopewell and Richmond. This area was targeted as computer generated random stations did not fall in this stretch of river during the 2000 study and was perceived as a significant data gap. A total of nine (9) stations have been included in this study, with the placement of eight (8) in the James River and one (1) in the Appomatox River. The completion of this study along with the two aforementioned efforts will provide adequate information to the Chesapeake Bay Program such that full characterization can be made in the James River, ranging from Jamestown Island to Richmond.

- Tidal Mattaponi and Pamunkey Rivers - These segments were also characterized as Areas of Insufficient or Inconclusive Data in the 1999 Chesapeake Bay Program report. Similar to the tidal James River, the EPA Chesapeake Bay Program also provided funds to monitor these river segments for toxics contaminants *(Characterization of Toxicity of Chemical Contaminants in Tidal Freshwater Reaches in Chesapeake Bay Tributaries. Maryland Department of Natural Resources, Annapolis, MD ,Proposa*). The assessment included a full chemical and biological assessment such that a full characterization can be made. Results have not yet been made available.

- Upper Middle York River – As part of the McGee et al. study mentioned, a sediment quality triad (chemical, toxicity tests, benthos) survey was performed at five (5) stations in the Upper Tidal York River. The conclusion from this study suggests this segment could be characterized as an Area of Low Probability for Adverse Effects due to chemical contaminants, with the caveat there may be localized impacts.

- Tidal Middle Rappahannock River – A toxics assessment on the Middle segment of the tidal Rappahannock River was conducted during the fall of *1998 (Hall L.W. et al., Ambient Toxicity Testing in Chesapeake Bay – Year 9 Report. Draft, U.S. EPA, Chesapeake Bay Program Office, Annapolis, MD, 2000, 88 pp. and appendices*). This study targeted ten (10) stations with an approach that included water column and sediment toxicity tests, chemical analyses of both media, all in conjunction with fish and benthic community assessments. The results in this segment were mixed. While half the stations showed no impacts due to chemical contaminants, potential problems were observed at the remaining stations. Water Quality Criteria exceedences for metals occurred at two stations. In addition, there was evidence of varying degrees of ambient toxicity and benthic impairment although it was difficult to correlate the observed effects with chemical contaminants. Follow-up study is recommended to confirm the results at selected stations.

The Elizabeth River

The Elizabeth River, a tidal tributary of the James River, is the major deep-water port of the Hampton Roads Harbor. The river system drains over 300 square miles in southeastern Virginia within the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach. The Elizabeth River serves as the focal point for military activities, industry, and commerce in the Hampton Roads area. The watershed is among the most heavily urbanized and industrialized areas in the state.

In 1993, the Chesapeake Bay Program identified the Elizabeth River system as a Region of Concern as it is one of the most highly polluted bodies of water in the entire Bay watershed. In March 1995, the Commonwealth of Virginia entered into an agreement with the Elizabeth River Project (ERP), a private nonprofit organization, to recommend actions toward an Elizabeth River Regional Action Plan for Toxics Reduction. ERP, a Norfolk-based partnership of citizens, industry, governments, military, and recreational interests, had independently formed to develop an integrated watershed action plan for management of ecological and human health risk.

Water quality monitoring for toxic pollutants and their effects has continued on the Elizabeth River. Past results from FY98-00 have been included in the report entitled "Summary of Key Findings for the State of the River 2000, November 1999 Elizabeth River Project." More recent monitoring that was not available for inclusion in the State of the River 2000 report is as follows:

- Benthic Index of Biotic Integrity (B-IBI) – A study of macrobenthic community health was initiated during the summer of 1999 in the Elizabeth River watershed. The results from the probability based sampling design (i.e., random) estimated the area of bottom communities not meeting the Chesapeake Bay Restoration Goal Index at 72% in 2000 compared to 64.3% in 1999. The observed impact is likely due to sediment chemical contaminants.

- Clean Dissolved Metals – Over the past few years clean metals data have been collected at 14 stations in the Elizabeth River. While several metals have been detected, only dissolved copper has been found at concentrations near or above the respective chronic water quality criterion.

- Fish Histopathology – Recent studies indicate that a small, abundant and non-migratory fish known as a mummichog is an excellent indicator of adverse health effects attributable to chemical contaminant exposure. An examination of internal organs shows that the presence of numerous types of lesions, including cancer, can be directly correlated with the presence of chemical contaminants in the environment. The results of monitoring performed on the Elizabeth River has shown a prevalence of lesions ranging from a low of 1.7% from fish collected in the Lafayette River and Western Branch to a high of 85% of the fish collected in the Southern Branch.

- TBT Monitoring – Tributyltin (TBT) data have been collected at 18 stations in the Elizabeth River, Hampton Roads and the lower James River six times a year since 1999. Ambient values typically range from one to ten times the chronic water quality criterion in the Elizabeth River.

In addition to the above, ambient water has been assessed for toxicity and low level concentrations of chemical contaminants. During July 2000, 4 stations were evaluated for their chronic toxicity potential to 4 different test species (2 fish sp. and 2 invertebrate sp.). The tests also served as a species sensitivity evaluation. The data generated from this evaluation suggested ambient toxicity should not exist in the Elizabeth River unless it is related to runoff from a storm event, a spill, or perhaps within a mixing zone. Therefore, ambient water toxicity testing is not presently used for monitoring purposes. To determine if low levels of organic chemicals were present in the water column, Semi-Permeable Membrane Devices (SPMDs), also known as artificial fish, were deployed in the water column at several locations. Even though organic compounds may be at low levels in the water column, they can adversely affect the overall health of the biota within the system. The SPMDs concentrate pollutants over time, which is an advantage over current analytical methods since they cannot detect or quantify chemicals in the water at these low levels. The results from the SPMDs confirmed the presence of several classes of compounds in the water column, including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organochlorine pesticides (OCPs).